

CLAIMS

1. A suspension system for a vehicle, including:

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means for supporting a wheel on a vehicle body,

said wheel support means including a hydro-pneumatic spring,

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a compensating spring means associated with the hydro-pneumatic spring,

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said compensating spring means being operable to act in opposition to the force exerted by the hydro-pneumatic spring as said hydro-pneumatic spring approaches full extension.

2. A suspension system for a vehicle as claimed in claim 1, including:

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an upper control arm,

a lower control arm,

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said control arms for supporting a wheel assembly on a body of the vehicle,

each control arm having an inner end and an outer end,

the inner end being connected by an articulated joint to the vehicle body,

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the outer end being connected by an articulated joint to the wheel assembly,

a hydro-pneumatic spring having an upper end and a lower end,

the upper end being attached to the vehicle body,

the lower end being attached to one of said upper and lower control arms,

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a compensating spring means which is operable as said hydro-pneumatic spring approaches full extension to act in opposition to the force exerted by the hydro-pneumatic spring.

10 3. A suspension system as claimed in claim 1 wherein the compensating spring comprises an elastic element of solid material.

4. A suspension system as claimed in claim 1 wherein the compensating spring is provided by a coil spring.

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5. A suspension system as claimed in claim 1 wherein the hydro-pneumatic spring has an oil chamber and an associated gas chamber with a separator piston or membrane therebetween, the spring means acting to reduce the force exerted by the separator piston or membrane on the oil in the oil chamber.

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6. A suspension system as claimed in claim 1 wherein the compensating spring is a coil spring located within the hydro-pneumatic spring.

25 7. A suspension system as claimed in claim 1 wherein the compensating spring is mounted externally of the hydro-pneumatic spring and is operable to reduce the force exerted by the hydro-pneumatic spring as said hydro-pneumatic spring approaches full extension.

30 8. A suspension system as claimed in claim 1 wherein the compensating spring is mounted in series with a check strap that limits the extension of the hydro-pneumatic spring.

9. A suspension system as claimed in claim 1 wherein the suspension system

includes an upper control arm and an associated lower control arm which locate a wheel with respect to a vehicle body, the hydro-pneumatic spring providing the suspension force tending to extend the suspended wheel away from the vehicle body and one or more compensating springs act between the vehicle body and one or both of the upper and lower control arms to reduce the suspension force as the hydro-pneumatic spring approaches full extension.

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10. A suspension system as claimed in claim 1 wherein the compensating spring is a torsion bar.
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11. A suspension system as claimed in claim 1 wherein the compensating spring is a hydro-pneumatic spring element.
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12. A suspension system as claimed in claim 1 wherein the hydro-pneumatic spring has a suspension actuator which is separate from but operably connected to a hydro-pneumatic element, the suspension actuator having two parts, namely a piston which is slidably mounted within an associated cylinder, one part for connection to the vehicle body and the other part for connection to the wheel support, the hydro-pneumatic element having a chamber containing oil and a chamber containing a gas separated by a separator membrane or piston, an oil chamber within the cylinder formed between an inner end of a bore of the cylinder and the piston, said oil chamber in the cylinder communicating with the oil chamber of the hydro-pneumatic element through a damping orifice.
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13. A suspension system as claimed in claim 12 wherein the compensating spring means comprises a compensating spring mounted in the oil chamber of the hydro-pneumatic element which acts to reduce the force exerted by the gas on the separator membrane or piston and hence the oil.
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14. A suspension system as claimed in claim 12 wherein a compensating spring is mounted within the cylinder of the suspension actuator on a side of the piston opposite to the oil chamber to resist the force exerted on the piston by oil in

the cylinder as the suspension actuator extends.

15. A suspension system as claimed in claim 12 wherein a second oil chamber is provided on the suspension actuator within the cylinder, said second oil chamber being formed between an outer end of the cylinder bore and the piston, said second oil chamber communicating with a compensating spring means formed by a hydro-pneumatic element comprising a chamber containing a gas and an associated chamber containing oil separated by a separator membrane or piston, the oil chamber of the compensating spring means being connected to the second oil chamber of the suspension actuator.

16. A suspension system for a vehicle, including:

an upper control arm,

a lower control arm,

said control arms for supporting a wheel assembly on a body of the vehicle,

each control arm having an inner end and an outer end,

the inner end being connected by an articulated joint to the vehicle body,

the outer end being connected by an articulated joint to the wheel assembly,

a hydro-pneumatic spring having an upper end and a lower end,

the upper end being attached to the vehicle body,

the lower end being attached to one of said upper and lower control arms,

a compensating spring means which is operable as said hydro-pneumatic spring approaches full extension to act in opposition to the force exerted by the hydro-pneumatic spring.

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